

## SOME OBSERVATIONS ON THE DENTITION OF THE NARWHAL (MONODON MONOCEROS<sup>1</sup>).

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It is the current belief of naturalists that, in the Narwhal, two teeth only are produced, both of which are situated in the upper jaw. In the female, as a rule, these teeth remain in a rudimentary state concealed within their sockets. In the male, on the other hand, the rule is for the right tooth only to remain rudimentary and concealed within its alveolus, but the left protrudes, grows in the adult to the length of several feet, and forms the well-known tusk or horn of this animal. Occasionally, however, the right tooth grows equally with the left, and like it projects for several feet beyond the mouth. In an interesting paper recently published Mr J. W. Clark of Cambridge<sup>2</sup> states that at least eleven bidental skulls may now be found in the various museums in Europe<sup>3</sup>.

With regard to the position of these teeth in the upper jaw a difference of opinion has been expressed by anatomists. The illustrious Cuvier stated<sup>4</sup> that the teeth were implanted in the intermaxillary bones, or in an alveolus common to the maxilla and intermaxilla; and this view has been adopted by various subsequent writers, by some of whom the tusk has been regarded as a peculiarly modified incisor tooth. But in a paper read, some forty years ago, to the Royal Society of Edinburgh<sup>5</sup>, Robert Knox pointed out that the tusks were carried in the maxillary bones; and this view of their position has recently been supported by Van Beneden and Gervais<sup>6</sup>, J. W. Clark, and W. H. Flower<sup>7</sup>.

<sup>1</sup> Read before the Royal Society of Edinburgh, May 20th, 1872.

<sup>2</sup> *Proc. Zool. Soc.* Jan. 17, 1871.

<sup>3</sup> In the Anatomical Museum of the University of Edinburgh is the skull of a male Narwhal, from the left supr. maxilla of which a tusk 33 inches long projects. The right maxilla has been in part removed, and a canal has been exposed, which extends as far back as the base of the beak, and is nearly 1 inch in diameter. From its length and the size of its bore it is not improbable that in this skull the right tusk had been developed and had protruded from the jaw, but the tusk and loose piece of the jaw have been lost.

<sup>4</sup> *Ossements fossiles*, v. Part I. 321, 322.

<sup>5</sup> *Transactions*, xi. p. 410. 1830.

<sup>6</sup> *Ostéographie des Cétacés*, p. 13.

<sup>7</sup> *British Medical Journal*, May 20, 1871.

Being desirous of satisfying myself on this point I have examined ten crania of this animal, all of which, with one exception, are in the Edinburgh Museums, and from what I have seen in them I entirely agree with the statement of the last-named anatomists. Five of these crania were males, three adult, and two from younger animals; two were females and three were well grown fetuses, and in all the specimens the maxillo-premaxillary suture was placed to the inner side of the alveolus for the tusk. In the adult male skulls this suture was situated in the inner wall of the alveolus, and it is probably from this circumstance that Cuvier considered that the socket was hollowed out of both the premaxillary and maxillary bones. But in the female and foetal crania the maxillary nature of the tooth was shown in so decided a manner that there could be no doubt as to its true position. In the female crania the teeth were situated close to the palatal surface of the bone, a little to the inner side of the outer edge of the maxilla, and in one specimen the rudimentary tooth lay concealed in its socket nearly two inches to the outer side of the maxillo-premaxillary suture. In the foetal crania the maxillary and premaxillary bones were readily separable from each other, and the socket of each young tusk was entirely situated within the superior maxilla.

The apparent participation of the premaxilla, in the formation of the socket of the developed tusk in the adult male, is undoubtedly due to a partial absorption, during the growth of the tusk, of the thin inner wall of the alveolus next the maxillo-premaxillary suture, in consequence of which the premaxillary bone forms a small proportion of the inner wall of the socket.

Owing to the maxillary position of the tusk it can no longer, therefore, be regarded as a peculiarly modified incisor tooth, but as it lies immediately to the outer side of the maxillo-premaxillary suture it should be regarded as representing a canine tooth.

In the course of my observations on the foetal crania, and on that of a young male, I observed an appearance which led me to think that, in addition to the well-known pair of teeth in the upper jaw, each superior maxillary bone had at one time contained another tooth. For situated close to the outer border

of the palatal surface of this bone was a canal, which passed backwards, parallel and inferior to the tusk-socket. In the young male this canal was two inches long, and opened in front one and a half inch behind the mouth of the socket for the tusk. It had the appearance of an alveolus, and on illuminating its interior, by reflecting light from the surface of a mirror, I perceived a minute denticle at the bottom of the socket.

Being so fortunate as to possess, through the kindness of Mr. C. W. Peach, a young male Narwhal (seven and a quarter inches long) with all the soft parts uninjured, I thought that I might perhaps be able to determine in it whether the Narwhal had originally more than two teeth developed in connection with its upper jaw. The surface of its palate was smooth and covered by mucous membrane, continuous with the tegumentary covering of the upper lip, but there was no appearance of teeth on the surface. When the more superficial part of the gum was however carefully cut off, two well-defined dental papillæ, each contained in its own tooth-sac, were exposed, imbedded in and completely enclosed by the gum which covered the outer edge of each half of the upper jaw, so that I can now state definitely that the Narwhal, at this early stage of development, possesses four teeth in the upper jaw. The more anterior of the two papillæ was two-tenths of an inch behind the tip of the jaw, and the more posterior lay about one-tenth of an inch behind the anterior.

Each dental papilla was so small as to be barely visible to the naked eye, and required the microscope to be employed for its further examination. Each papilla was continuous at its base with the connective tissue of the mucous membrane of the gum, from which it projected into the cavity of the closed-in tooth-sac. It was somewhat clavate in form, and was separated from the inner surface of the tooth-sac by a slight interval. When examined with high powers of the microscope, the papilla was seen to consist of small, pale, nucleated corpuscles, imbedded in a delicate and apparently homogeneous matrix. Some of these corpuscles were rounded, others oval, whilst others again were distinctly caudate. Corpuscles, similar in form, were collected in considerable numbers at the base, and

in the connective tissue immediately adjacent to the base of the papilla, whilst throughout the connective tissue of the gum numerous characteristic connective tissue-corpuscles were seen. There was no trace of calcification of the dental papilla. The free surface of the papilla was limited by a sharp, definite outline, as if a membrana limitans invested it, but no distinct separable membrane was demonstrated, so that the sharpness of definition was probably due to the tissue of the papilla being more condensed near the surface.

The wall of the tooth-sac was entirely surrounded by the connective tissue of the mucous membrane. Its relation to the dental papilla showed it to be homologous with the enamel organ in man and those animals where enamel enters into the structure of the teeth. All connection was severed between it and the epithelium of the mouth, of which it had been, in all probability, originally an involution. It measured about  $\frac{1}{50}$ th of an inch in thickness, and was not homogeneous, for its outer and inner portions were denser than a more delicate intermediate portion. It was composed of pale nucleated corpuscles, about equal in size to those which entered into the formation of the dental papilla. These corpuscles were ovoid in form, and I failed to recognise any elongation of the cells which formed the inner portion of the tooth-sac into columnar epithelium, by the calcification of which the rods or prisms of the enamel are produced in man and in those animals in which enamel forms a part of the structure of the tooth. No membrana limitans was seen on either the inner or outer surfaces of the wall of the tooth-sac.

It is customary to state that the tusk of the Narwhal is destitute of enamel, and consists of dentine with an external covering of cement. As the examination of this young foetus revealed the existence of a structure homologous with an enamel organ, though at a stage too early to exhibit its characteristic epithelium, I thought it advisable to examine anew the microscopic character of the tusk to see if there might not be, especially at the tip, some trace of an enamel covering. I accordingly removed a thin slice from the tip of one of the unprotruded, and therefore unworn, tusks of a well-grown foetus. The general substance of the tusk consisted of well-formed

dentine, but at the tip a depression extended for some distance into this tissue. This depression was filled up with crusta petrosa, continuous with that which formed the external investment of the tusk. The crusta in the immediate neighbourhood of this depression contained not only lacunæ with canaliculi proceeding from them, but groups of fine canals, which resembled in size and appearance dentine tubes. Between the dentine and the crusta petrosa was a thin ill-defined layer into which the dentine tubes penetrated, and which obviously corresponded to the so-called granular layer of the dentine in a human tooth. No trace of enamel rods could be seen.

The inner surface of the wall of the tooth-sac was not perfectly smooth, but possessed one or more ridge-like projections, which fitted into corresponding depressions on the outer surface of the dental papilla. It is, without doubt, to this arrangement, that the depression in the dentine at the tip of the tusk of the well-grown foetus owes its origin.

There is no reason to think that the more anterior of the two teeth seen on each side of the upper jaw of this foetus had to the more posterior the relation of a milk-tooth to a permanent tooth. For they were both almost precisely equal in size and in comparative development, which would not have been the case if the latter had had to act as the successor to the former. In all probability the more anterior would have developed into the maxillary tusk, and the posterior either have disappeared altogether, or formed one of those irregular non-protruding teeth, such as Berthold described some years ago in the skull of a young Narwhal which he examined<sup>1</sup>.

No rudimentary teeth were found in the lower jaw, although it was carefully examined.

The ossification of the fibrous basis of the maxillary bones was so imperfect that it was not possible to distinguish the maxillary from the premaxillary segment. But in the lower jaw, the ossification of the fibrous membrane, which invested Meckel's cartilage, had advanced to a considerable extent.

<sup>1</sup> Müller's *Archiv*, 1850, p. 386.